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# Revisiting Revisitation in Computer Interaction: Organic Bookmark Management

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*Abstract: According to Milic-Frayling et al. (2004), there are two general ways of user browsing i.e. search (finding a website where the user has never visited before) and revisitation (returning to a website where the user has visited in the past). The issue of search is relevant to search engine technology, whilst revisitation concerns web usage and browser history mechanisms. The support for revisitation is normally through a set of functional built-in icons e.g. History, Back, Forward and Bookmarks. Nevertheless, for returning web users, they normally find it is easier and faster to re-launch an online search again, rather than spending time to find a particular web site from their personal bookmark and history records. Tauscher and Greenberg (1997) showed that revisiting web pages forms up to 58% of the recurrence rate of web browsing. Cockburn and McKenzie (2001) also stated that 81% of web pages have been previously visited by the user. According to Obendorf et al. (2007), revisitation can be divided into four classifications based on time: short-term (72.6% revisits within an hour), medium-term (12% revisits within a day and 7.8% revisits within a week), and long-term (7.6% revisits longer than a week).*

**Keywords:** Web Browser, Organic Revisitation, Re-Finding, Bookmark Management, User Interface Design

## Introduction of Revisitation

**W**ITH OVER TWO billion current users of the WWW (one third of the world's population) and immense data flows, the area of web browser revisitation tools and strategies has been overlooked (Group 2010).

The process of revisitation involves viewing the browser history which helps you to trace your online journey, i.e. what you have done, what documents you have used, what web sites you have visited, what images and movies you have seen and various other activities you have performed. According to Milic-Frayling et al. (2004), there are two general ways of user browsing i.e. search (finding a website where the user has never visited before) and revisitation (returning to a website where the user has visited in the past) (Milic-Frayling 2004). The issue of search is relevant to search engine technology, whilst revisitation concerns web usage and browser history mechanisms. The support for revisitation is normally through a set of functional built-in icons e.g. History, Back, Forward and Bookmarks. Nevertheless, for returning web users, they normally find it is easier and faster to re-launch an online search again, rather than spending time trying to find a particular web site from their personal bookmark and history records. Therefore, there appears to be a problematic design issue based on the overall concept of revisitation which will form the central theme of this research paper.

Revisitation is a basic browsing behavior of the user. A number of empirical studies have provided valuable data, with regards to the user's performance in web navigation. Tauscher and Greenberg (1997) showed that revisiting web pages forms up to 58% of the recurrence rate of web browsing (Tauscher 1997). Cockburn and McKenzie (2001) also stated that 81% of web pages have been previously visited by the user (Cockburn and McKenzie 2001). According to Obendorf et al. (2007), revisitation can be divided into four classifications based on time: short-term (72.6% revisits within an hour), medium-term (12% revisits within a day and 7.8% revisits within a week), and long-term (7.6% revisits longer than a week) (Obendorf, Weinreich et al. 2007). Based on these revisitation patterns, clearly the need is for a short-term memory system which could display this information in a more useful graphical means rather than the current system of textual lists.



### ***The Market Share of Current Web Browsers (The Browser Wars)***

Web browsers, such as Microsoft's Internet Explorer, Apple's Safari, Mozilla Firefox, Google Chrome, and Opera, are software applications which enhance the user's experience of surfing the World-Wide Web (W3), as it is commonly referred to. The most popular of these are shown in Figure 2 below.

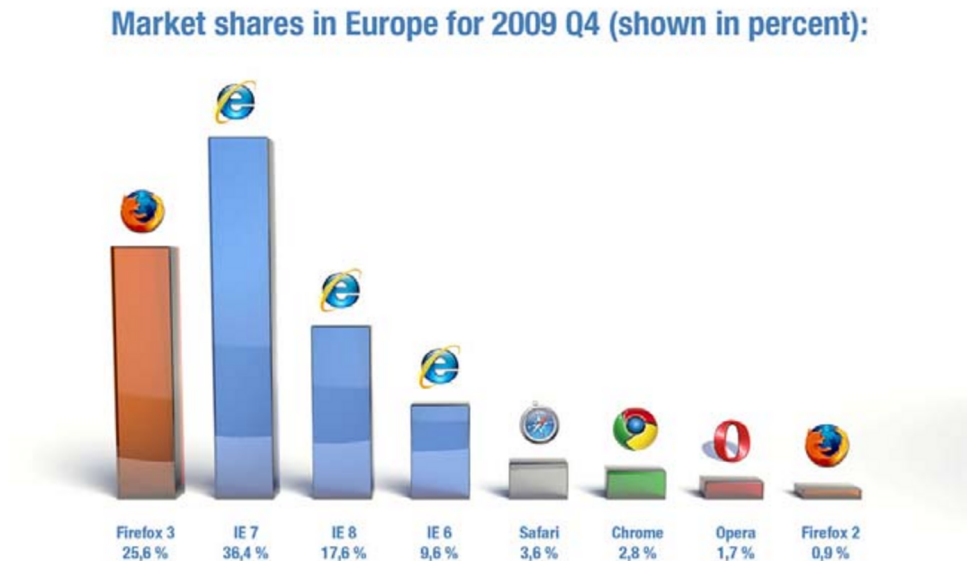


Fig. 2: Comparison of Web Browsers Market Shares (ADTECH 2010)

Each of these web browsers has their own distinct interface design, such as menus and visual icons, even though there are some visual similarities that indicates specific functionality like Back and Forward, and the procedure to organize personal information such as Bookmarks and History.

### ***The Management of Bookmarks***

The Bookmarks function allows the user to save and organize their desired websites for future reference. The management of Bookmarks depends on the willingness and capability of an individual to categorize and tag information. Nevertheless, users often find it time-consuming to retrieve web pages in their personal collection of Bookmarks, and some would rather start a new search again rather than store and categorize. This is due to the fact that bookmark management systems rely heavily on directory or keyword (tagging) mechanisms for labeling bookmarks. If the directory or keywords are not properly organized or, even worse, the directory or keywords are forgotten, the retrieval of the information can be a very daunting task.

It has been stated that Bookmarks maintenance is one of the top three usability problems on the web (Pitkow 1996). There has been some research on improving the Bookmarks

function. In Data Mountain for instance, users can place documents at arbitrary positions on an inclined plane in a 3D desktop virtual environment using a simple 2D interaction technique. It makes use of human spatial memory and is designed to assist users to identify and distinguish documents both through their thumbnail representation and through popup titles (Robertson, Czerwinski et al. 1998). However, the main problem with Data Mountain is that the use of screen shots as its visual representations of the Bookmarks could turn into visual chaos, when hundreds of bookmarks appear on the screen all at the same time, and lead users to find difficulties to locate the desired information.

### ***The Management of History***

The History function in web browsing can be regarded as a record that allows the user to track their previously visited web pages. The techniques used by commercial and open source web browsers are varied. Internet Explorer uses a “temporal chunks” mechanism, in that the pages can be recalled based on their distance in chronological order (usually up to three weeks), alphabetical order of web sites, and alphabetical order of page titles (Cockburn and McKenzie 2001). In Internet Explorer 8, the History feature is combined with the Favorites and the RSS feed, whereby the user could sort History lists up to three weeks by site name, most visited sites, order visited today, and date. Similarly, in Mozilla Firefox 3.6, History can be viewed by Site, Date, Date and Site, Most Visited and Last Visited order. Nevertheless, this visual display of linear History lists has its drawbacks. The user may experience frustration when the desired web pages could not be found within the History list or they were unable to retrieve a website visited a month before.

Over the last 15 years, there have been many suggestions for the use of a branching History display that would provide a two dimensional visualization of web browser sessions. WebNet proposed by Cockburn and Jones (1996) used nodes and lines to present a view in hierarchical structure (Cockburn 1996). The layout of MosaicG by Ayers and Stasko (1995) is a two dimensional tree structure that provides both spatial and temporal context to help users' orientation (Ayers and Stasko 1995). Other systems have been proposed, such as PadPrints that shows a graphical History map of visited pages (Hightower, Ring et al. 1998) and Footprints that used site maps and paths to present visual histories (Wexelblat and Maes 1999). It is said that the major limitation of the work on web site revisitation schemes is the lack of empirical evaluation (Cockburn and McKenzie 2001).

### ***The Use of Metaphors***

The use of alternative metaphors has been suggested by various researchers to enhance browsing and revisitation. For example, the implementation of the “dog earring” metaphor appeared in some research. Kaasten and Greenberg (2001) used dog-ears to mark pages on the list in order to replace Bookmarks (Kaasten and Greenberg 2001). HyperHistory was employed by the metaphor of dog-earring as a way to mark the level of the importance of the pages (Nagel and Sander 2005). To facilitate the folder filing systems and information organization, a “pile” metaphor has been used (Rose, Mander et al. 1993). Agarawala and Balakrishnan (2006) adopted physical real-world properties such as friction and mass to help users to organize information on the desktop. A physic simulator allows visual representations to be dragged and tossed around with the feel of realistic characteristics, and objects can

collide and displace each other. They integrated the “pile” metaphor with the physics-based desktop and the pen-based interfaces in direct manipulation (Agarawala and Balakrishnan 2006).

### **Summary**

As discussed in the previous sections, various researchers around the world have put a great deal of effort into redesigning the visualization and improving the techniques used within web browser features and the overall look and feel of the interface. Furthermore, there have been a few design suggestions for enhancing and integrating features to support revisitation. Kaasten and Greenberg (2001) proposed to combine Back, History and Bookmarks in web browsers (Kaasten and Greenberg 2001). Nagel and Sander (2005) presented HyperHistory to fix the web browser’s History function drawbacks and enhance bookmark organization in supporting navigation and information retrieval (Nagel and Sander 2005). Similarly, Tabard et al. (2007) developed PageLinker that allows users to create and present links on specific pages or set of pages on bookmarks for biologists (Tabard, Mackay et al. 2007). Other commercial and open source products are available, such as BrowseBack where the user can search the web history through keywords and view thumbnails of web pages; MindRetrieve which is a search engine that indexes web pages, these can then be viewed offline and are ranked by relevance (BrowseBack 2009; MindRetrieve 2009).

It is said that users tend to build large bookmark collections and the current interface schemes become unwieldy (producing extremely long textual menus), forcing users to re-organize their bookmark structure (Cockburn and McKenzie 2001). To solve this problem, we propose a new method which makes use of an analog of growing plants, hence the term Organic Bookmark Management (OBM), to manage and organize information in bookmarks. This new OBM visualization aims to increase information retrieval making it more efficient and effective. By integrating the application into the web browser, OBM can build on existing functionality to trace the visited pages and recreate a totally fresh visual look and feel.

### ***The Concept of Organic Bookmark Management (OBM)***

Based on the previously discussed literature review, we are able to obtain relevant knowledge and generate insights into the development of web browser features and their functionality. In terms of re-finding and revisitation, the current generation of web browsers relies on the individual’s capability and willingness to organize his or her bookmarks and history. Therefore, the crucial element is how to assist the user with visual management of data. Blanc-Brude and Scapin (2007) found that the file location, file type, keywords, associated events (such as emails and phone calls) and visual elements are the best remembered recalled attributes by the users (Blanc-Brude and Scapin 2007). Furthermore, several studies have suggested that the use of thumbnail previews is helpful in search engines (Czerwinski, Van Dantzich et al. 1999; Kaasten and Greenberg 2001). Dziadosz and Chandrasekar (2002) conducted an empirical evaluation of the use of thumbnail previews in web search results. The results showed that the combination mode of text summaries and thumbnail previews is better than text-only summaries and thumbnail previews only (Dziadosz and Chandrasekar 2002). These research results are valuable for forming the design of the OBM user interface. Most file types are based on HTML, and are not as meaningful on the web. File location and

visual elements such as thumbnails are useful. Therefore, it is proposed to integrate these elements into OBM to facilitate revisitation.

## **Research Methods**

In order to have a qualitative understanding of how an individual performed when he or she was browsing, and what level of efforts required to organize and manage his or her History and Favorites (Bookmark), the formative studies were conducted in September/October 2010 at the College of Art and Humanities, National Formosa University (NFU). A total of 40 participants were recruited (20 male, 20 female) and were paid 800 NTS (approx. 25 USD). Within the first part of the study, we gathered the user's background information; this was followed by 17 further general questions relating to the use of the History and Favorites (Bookmark) functions:

(a) gender: males vs. females; (b) educational background: high school vs. college vs. university vs. higher qualification; (c) level of computer experience: 0-2 yrs vs. 2-4 yrs vs. 4-6 yrs vs. 6-8 yrs vs. 8-10 yrs vs. >10 yrs; (d) daily use of the Internet: 0-2 hrs vs. 2-4 hrs vs. 4-6 hrs vs. 6-8 hrs vs. 8-10 hrs vs. >10 hrs; (e) the user's regular computer platform: PC vs. Mac; and (f) type of web browser of daily use: IE vs. Firefox vs. Safari vs. Chrome vs. Others. These six variables were tested independently to evaluate overall usability. For the second part of the study, a small sample of the participants including novice, intermediate, and experienced users, was selected to do recall and recognition testing on the Organic Bookmark Management (OBM) prototype based on their personal History and Favorites (Bookmark) data submitted during the initial screening.

### ***Organic Bookmark Management (OBM) Prototype***

As mentioned previously, several metaphors have been employed to aid recall and cognizance, such as the two dimensional dog-erring and three dimensional pile metaphors. We would rather not to pursue this path, but to focus on the garden metaphor that people are more familiar with and are easier to build on top of the existing web browser APIs.

It is said that the selection of an appropriate metaphor in interface design could be beneficial to user interaction. The current standardized office metaphor of the desktop may not prove to support all users from different cultural backgrounds. For example, Indian users are more familiar with the concept of bookshelves, books, chapters and pages, rather than files, folders and multiple pages (Marcus 2001). The garden metaphor proposed by Shen et al. (2006) has been employed to web browsers with promising results (Shen, Woolley et al. 2006; Shen, Prior et al. 2009; Shen, Prior et al. 2009). The OBM prototype has been based on the garden metaphor to aid web browser revisitation.

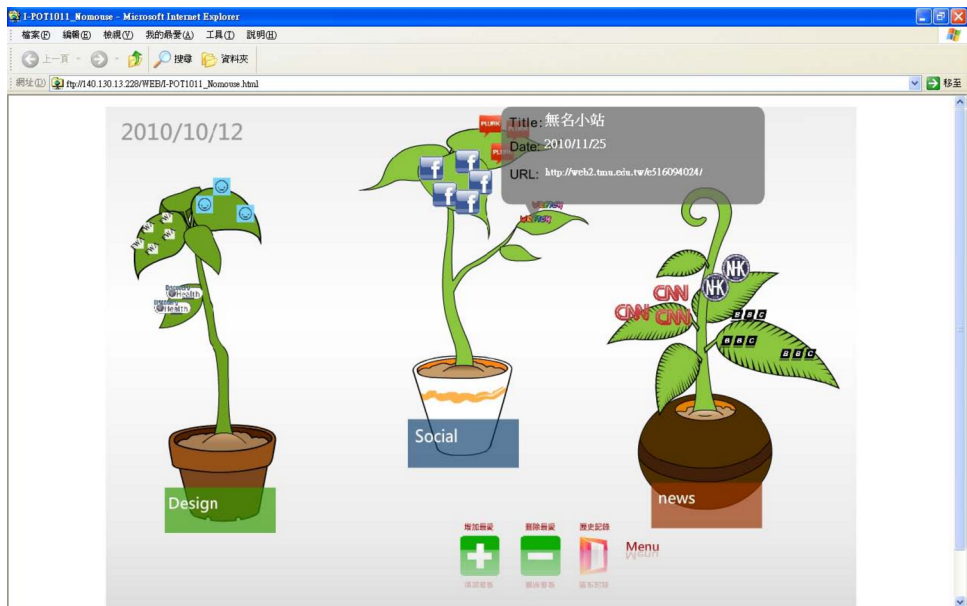


Fig. 3 - Organic Bookmark Management (OBM) Screenshot.

The initial visual view of OBM's bookmark management is based on the ideal of a literal "tree-view". The OBM window acts as a "close-up" of a particular area or project, and has a horizontal view. By extending the garden metaphor to the bookmark system it is decided to use plant related components. The components of the OBM include the following:

- A plant 'Patch' to represent the name of the plant or family.
- A plant 'Pot' which represents the primary folder.
- 'Branches' that represent the levels and connections.
- 'Leaves' that symbolize data files.
- 'Flowers' or 'Fruits' which represent a favorite Favorite location or special file.

Other components that are to be considered include: seeds which symbolize a new project, reproduction, replication, duplication, multiplication. The "freshness" to a recent file may be colour coded. Flowers or fruit can be colour coded to symbolize completion or importance or favorites. Insects may play a part in moving or compressing files. To indicate a type of project or a family relationship a plant species could be made visual.

## Discussion of the Results

In the first part of the study, a comparative experimental evaluation involving 40 participants was conducted via email.

The average age of the 40 participants was: males (23.45 years old with  $sd=4.82$ ), while the average age of females was 24.10 years old with  $sd=5.53$ . For the level of education, most of the participants had a university background (male 85%, female 75%), and a many with a higher education background (male 15%, female 25%).



A majority of the participants had over ten years of computer experience (60% for both male and female), 8-10 years was 25% males and 40% females, and 4-6 years was 15% males. In terms of daily internet use 55% of the males and 60% of the females spent more than 8 hours surfing.

A surprising 20% of the males and 20% of the females spent over ten hours surfing the web. All males used PC, and one male used both a PC and a Mac, while 90% of the females used a PC and 10% used a Mac.

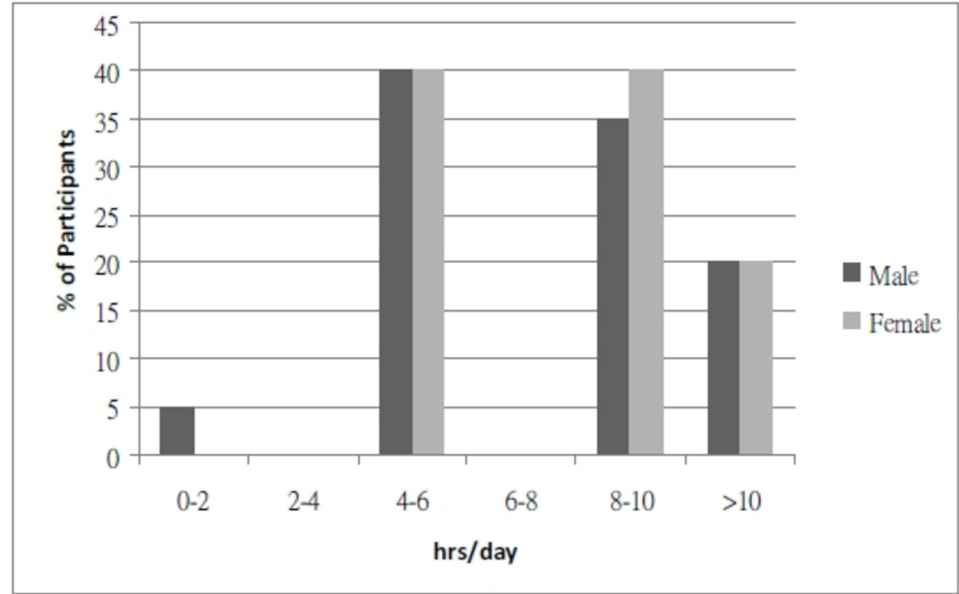


Fig. 4 - Use of the Internet Hours/Day

Microsoft’s Internet Explorer is still the most popular web browser for the participants (65% males and 70% females), Firefox had 30% males and 20% females, and Google Chrome was used by 20% of the males and 10% of the females. It is interesting to note that the use of localized web browser named ‘KKMan’ was used by 5% of the males.

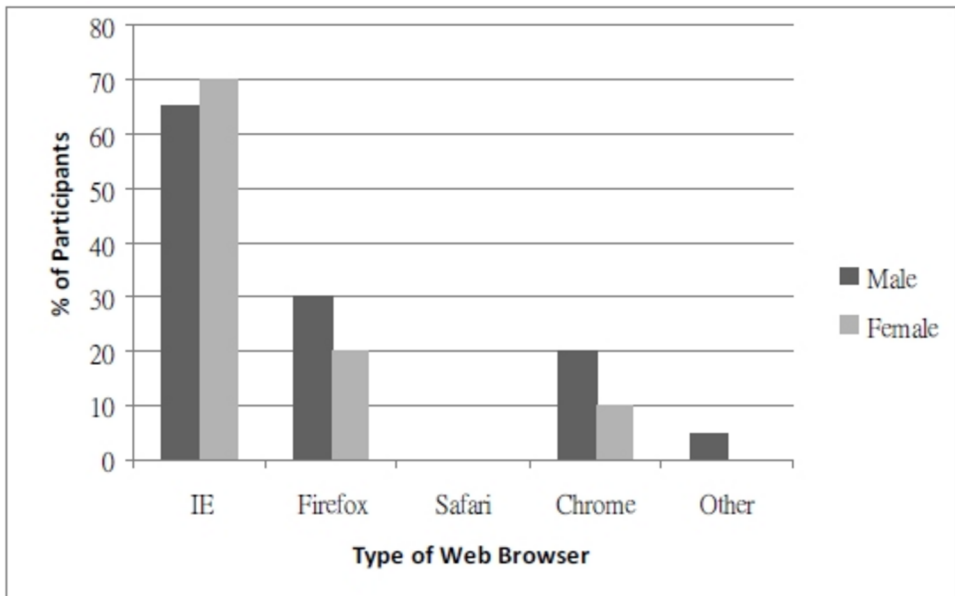


Fig. 5: Type of Web Browser in Use

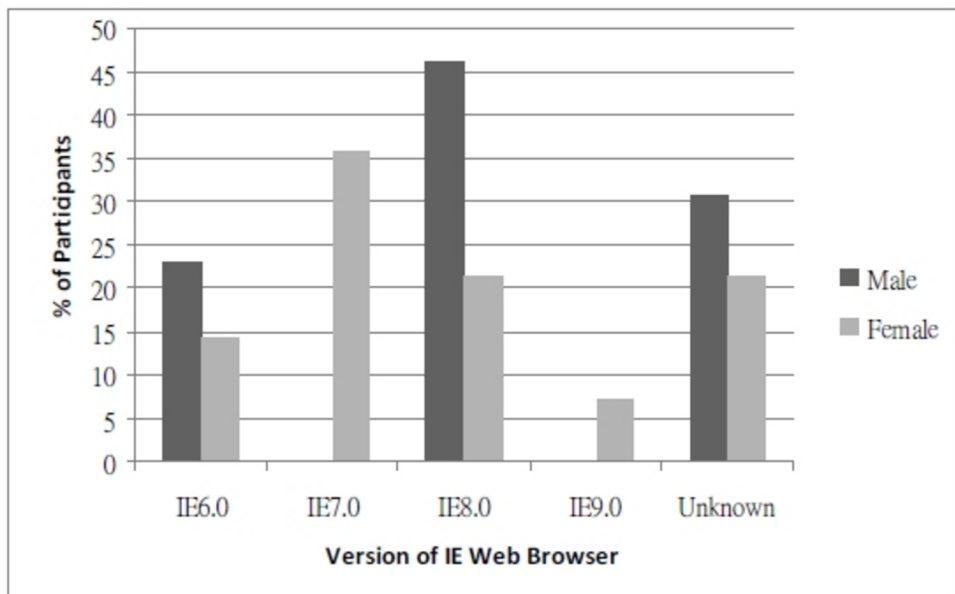


Fig. 6: Version of IE Web Browser in Use

In terms of the History function, all participants were aware of it. However, there were 40% of the males and 65% of the females who didn't use it at all.

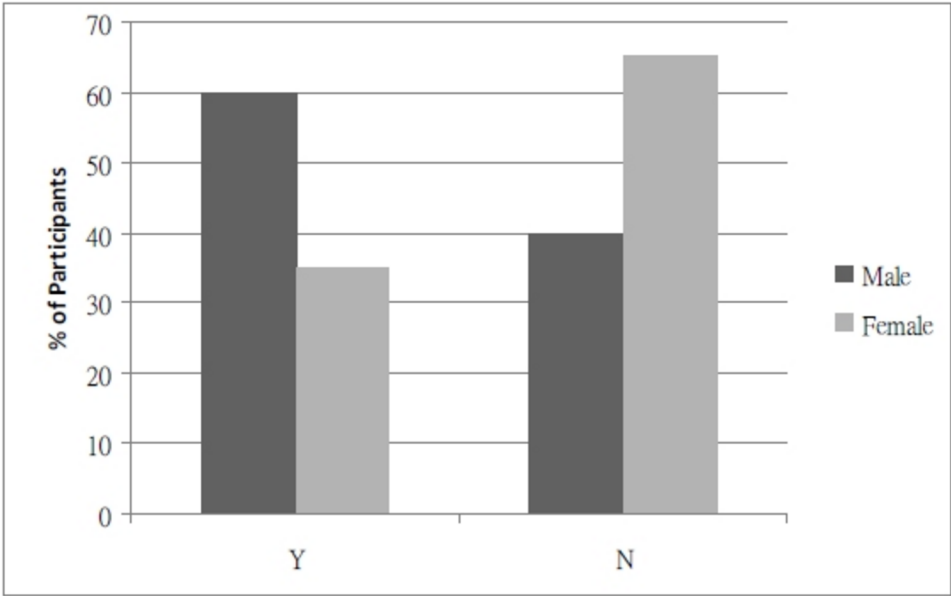


Fig. 7: Regular use of the History Function for Revisitation

When asked the reason, 25% of the males and 31% of the females thought that the History function was difficult to understand and confusing to use.

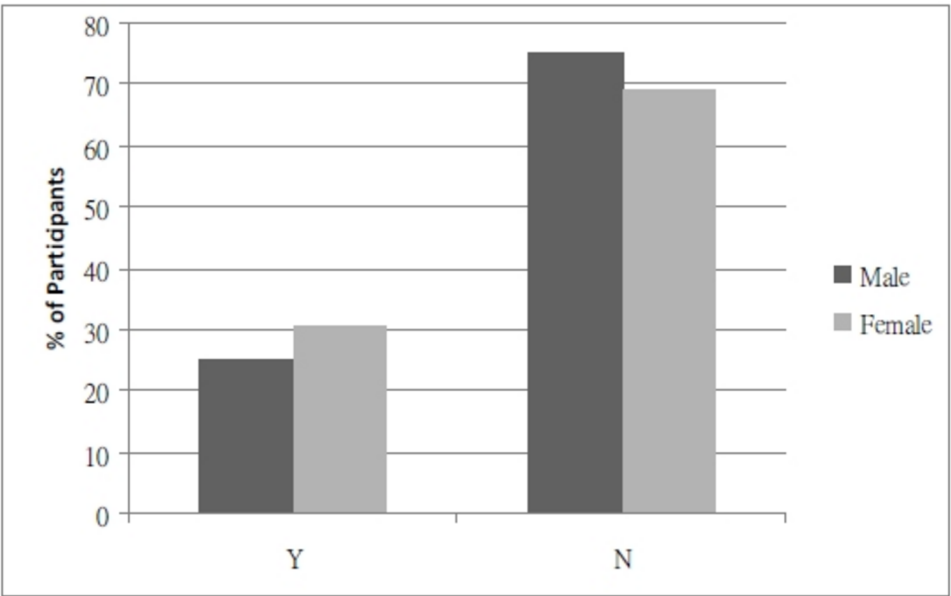


Fig. 8: The Difficulty to Understand the History Function

The majority of the users (95% males and 100% females) did know that the History function could display all the websites that they had visited in the last few weeks.

Nevertheless, 25% of the males and 45% of the females did not know that the default History setting could be changed from 21 days to whatever the user may wish.

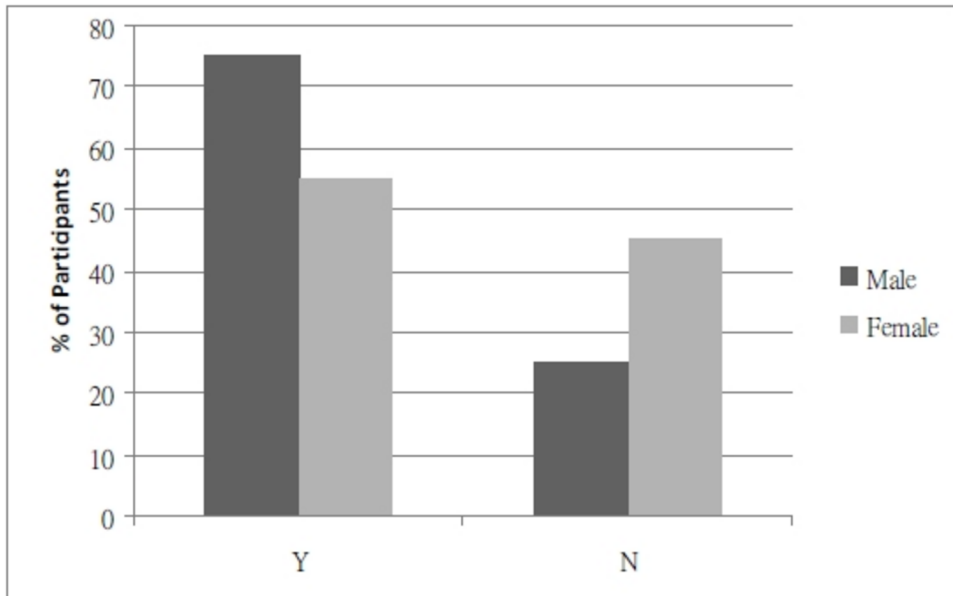


Fig. 9: User Knowledge of the Default History Function

95% of the males and 80% of the females were aware that the History function could show the visited web pages in terms of Dates, Sites, Most Visited and Order Visited Today. However, 25% of the males, and 50% of the females did not know that you could use a keyword to search within History.

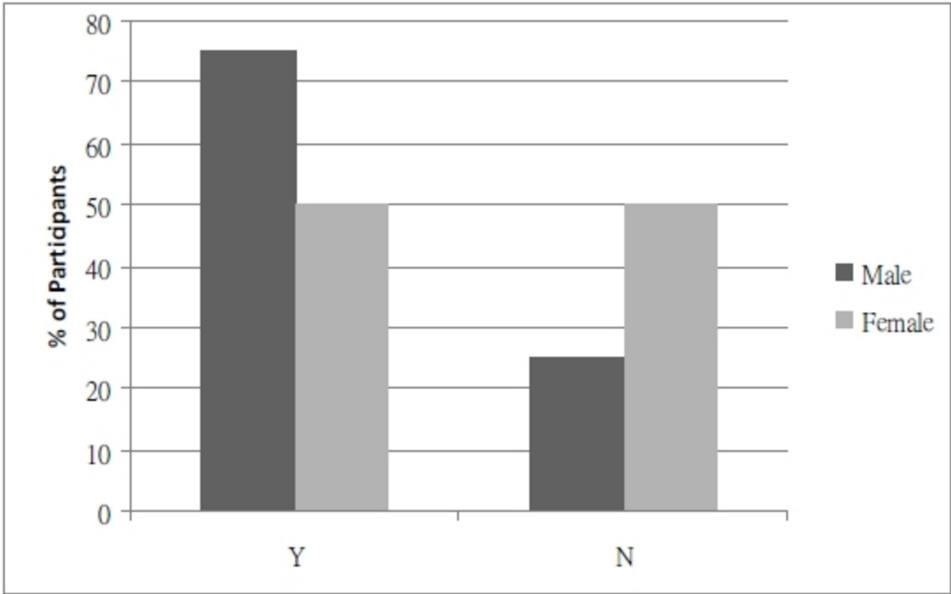


Fig. 10: Knowledge of using a Keyword in History

In terms of the Favorites (Bookmark) function, all the participants were aware of it. Interestingly, it was found that 95% of the males and 100% of the females regularly used it to save web pages. Nevertheless, there were 20% of the males and 5% of the females who found it difficult to manage it, whilst only 10% of the males did not know how to organize Favorites (Bookmark). This can be explained by the standardization of the available existing browsers that forces users to adopt and surpass the learning curve.

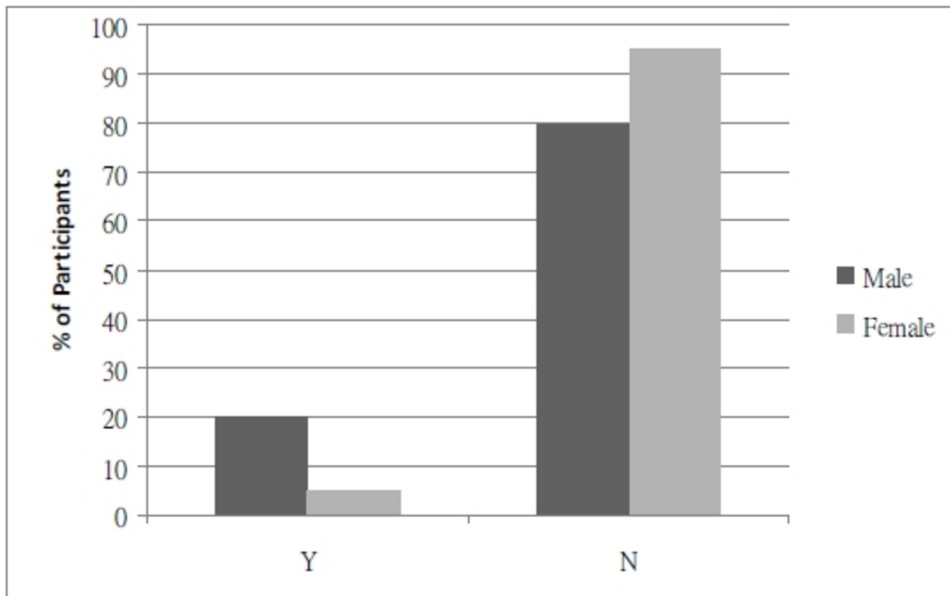


Fig.11: The Difficulty to Manage Favorites (Bookmark).

There were 40% of the males and 35% of the females who often experienced problems revisiting a web page that they knew that they had been to in the recent past.

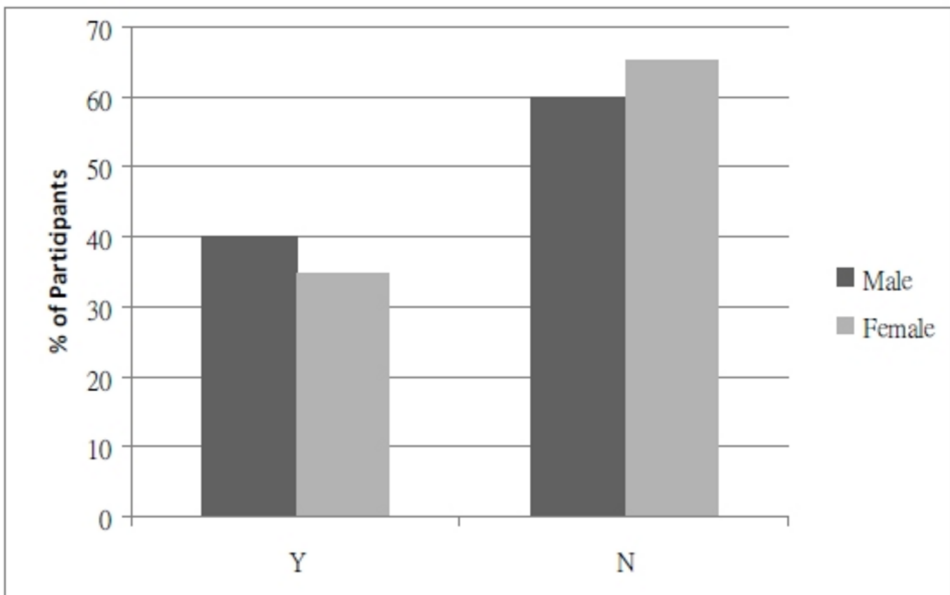


Fig.12: The Difficulty to Revisit and Find web Pages in Recent Past

When asked about how they normally found web pages that they knew they had been to before, there was a mixed response.

The order of preference being: [1] Using the Favorites function, [2] Using the History function, [3] Direct entry of the URL followed by [4] Google Search.

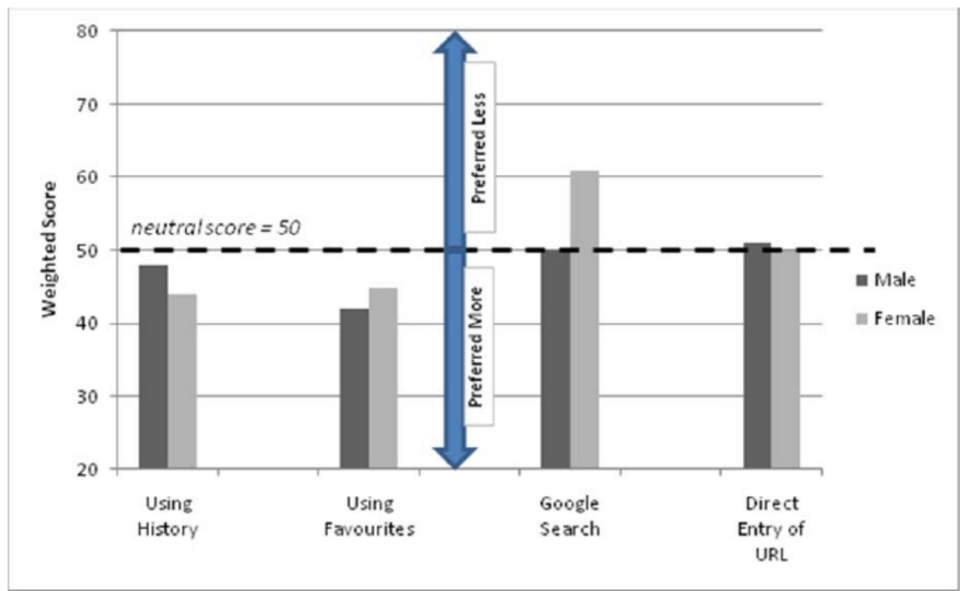


Fig.13: Order of Preference of Search Patterns

On average, the male participants visited between 104 to 300 web sites in the past three weeks, while the female participants had visited between 69 to 275 ones. When the participants history logs were examined it was found that they revisited web pages from social networking sites such as Facebook, blogs, news, learning portals, entertainment such as online movies, YouTube, music and games, etc. Analysis of their Favorites folders showed a mean of 16 ( $sd=10.44$ ) folders for the males and a mean of 14 ( $sd=8.12$ ) for the females.

**First Organic Bookmark Management Prototype and Evaluation**

In order to gauge the level of support amongst computer users for revisitation, we selected three participants from the group which included one novice, one intermediate, and one experienced user to do recall and recognition testing on Organic Bookmark Management (OBM) prototype based on their personal History and Favorites (Bookmark) data provided in the first user study. There were two males (one was advanced and another was intermediate), and one female who was a novice. The OBM prototype was given to them to try and test in their own time. Based on the Likert scale, they found OBM easy to understand (two males Totally Agreed and one female Agreed). All three agreed that they found OBM easy to manage their Favorite (Bookmark). For the use of History, two males totally agreed that OBM was easy to view, while one female disagreed. For the ease of use and organize the OBM system, the advanced male totally agreed, the novice female agreed, and the interme-

diate male kept neutral. Two males (advanced Totally Agree and intermediate Agree) found OBM's timeline was helpful in revisitation, while the novice female disagreed. They further suggested how to improve the OBM system by adding more functions such as RSS Reader and Feed for further usability testing.

## Conclusion and Further Work

According to StatCounter Global Stats in September 2010, Microsoft's Internet Explorer browser had fallen to below 50% of the worldwide market for the first time. This is a clear result of the success of the Firefox browser (currently on 32% and growing) (StatCounter 2010). The market for web browsers is highly competitive and with the recent introduction of Google's Chrome, which has more than tripled from 3.7% to 12% in (2009-2010), it is getting ever more crowded. The management of browsed information may be a key differentiator between systems.

Analysis of our results shows that most participants (60% of male and female) were regarded as expert uses of computers, many with more than 10 years experience. Over half the male and female participants surfed the Internet for more than 8 hours a day.

The vast majority of participants were PC users. It is interesting to note that our participants group (both male and female) were broadly in line with the worldwide statistics for the use of web browsers with 65-70% IE and 20-30% Firefox. Of the IE users, males were more than twice as likely to have the latest version of the IE 8 software (46% as opposed to 21%).

Even though 100% of the participants were aware of the History function, there were still 40% of the males and 65% of the females who did not regularly use it. This was overwhelmingly due to it being perceived as unhelpful, confusing or difficult to use.

Almost all the participants were aware that the History function could display all the websites that were visited in the last few weeks. Nevertheless, 25% of the males and 45% of the females did not know that they could change the default History duration from 21 days to whatever they liked. The majority of participants knew the level of functionality within the History function; however, four times as many women (20%) as men (5%) did not. Moreover, 25% of the males and 50% of the females did not know that you could search the History function using a keyword.

There appears to be a gap in knowledge between the males and the females as to some of these basic functions. Is it that they never learnt about them, or is it that they simply don't find them easy to use and therefore they do not use them at all?

All of the participants were aware of the Favorites (Bookmark) function and almost all of the participants used this function. Nevertheless, almost all the participants (80% male & 95% female) found it difficult to manage their Favorites (Bookmarks). When asked about the problem of revisiting a web page that they knew they had been to in the recent past, 60% of the males and 65% of the females stated that they often experienced problems with this.

The use of the Favorites and History functions is popular, when asked about how they normally found web pages that they knew they had been to before, there was a mixed response. This indicated that there is room to offer alternative visually-oriented management strategies which might enhance revisitation. The level of acceptability for users to adopt the OBM system over the traditional offerings from Internet Explorer and Firefox remains challenging. However, an add-in software extension to IE and Firefox would seem practical and beneficial.



The results of this formative study provide a solid foundation for future development of the OBM system. We believe that even the most successful browser, i.e. Internet Explorer can be improved by redesigning their Favorites and History functionality.

The strength of the OBM system lies in the user's ability to recognize and interpret its functionality when taken out of context. Further issues that we would like to explore include greater levels of functionality, 3D depth perception, improved timeline performance and greater data management capability.

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